

**Remarks/Arguments:**

Claims 1-3 and 5-12 are pending in this application. With this response, Applicants amend claims 1, 6 and 12 and add new dependent claims 13, 14 and 15. Accordingly, claims 1-3 and 5-15 are now presented for reconsideration. No new matter has been added.

Applicants' invention is directed to a hermetic compressor having grooves provided at an upper side and a lower side of the outer circumference of a piston. The outer shape of the grooves communicates with a space in the hermetic container at least when the piston is in the bottom dead center position.

**Claim Rejections Under 35 U.S.C. §103**

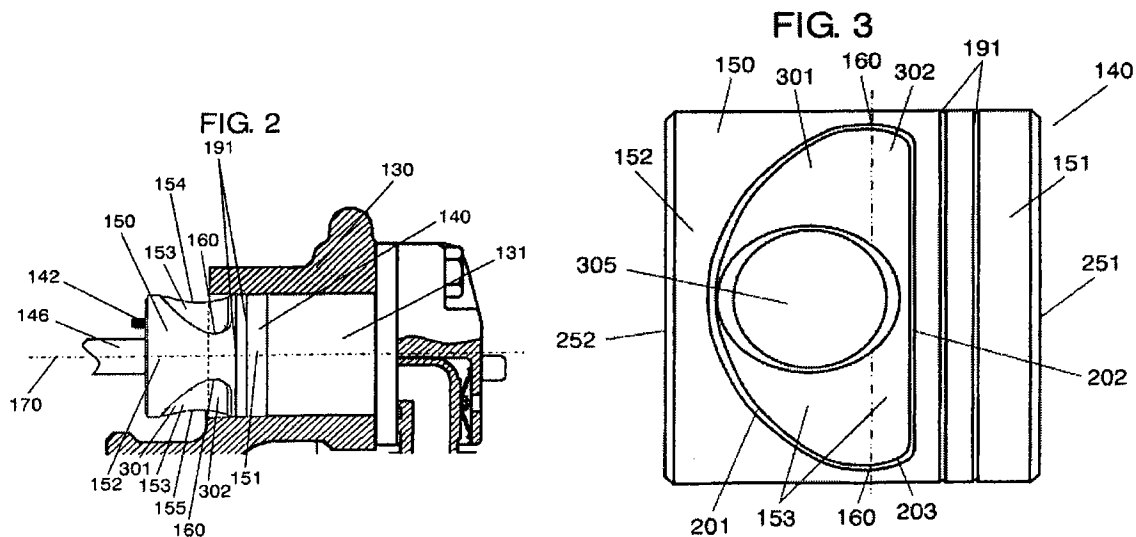
Claims 1-3 and 6-12 are rejected under 35 U.S.C. § 103(a) as unpatentable over Japanese Patent Publication No. 2003-065236 (hereinafter "Katayama") in view of U.S. Patent No. 5,076,226 (hereinafter "Watanabe"). Claim 5 is rejected under 35 U.S.C. § 103(a) as unpatentable over Katayama in view of Watanabe and further in view of U.S. Patent No. 5,092,747 (hereinafter "Irino"). Applicants respectfully submit, however, that the claims are patentable over the art of record for at least the reasons set forth below.

Katayama is directed to a hermetic compressor with an annular lubrication groove recessively formed on an outer periphery of the piston. Watanabe is directed to a piston with recesses that are formed in the skirt proximate each thrust surface. The recesses of Watanabe continue to the skirt end. Irino is directed to a fluid compressing apparatus that may be used with hydrocarbon refrigerants.

Applicants' invention as recited by claim 1, includes features which are neither disclosed nor suggested by the art of record, namely:

**... the outer shape of the grooves is a closed semicircular shape extending toward a skirt side of the piston**, and the semicircular shape includes a first outer shape extending toward the skirt side of the piston, a second outer shape parallel to the top surface of the piston, and a third outer shape linking the first outer shape and the second outer shape, and a curvature of the first outer shape is smaller than that of the third outer shape ...

(Emphasis added). These features are found in Applicants' originally filed specification at page 9, line 21 to page 10, line 12 and in FIGS. 2 and 3 which are reproduced below. No new matter has been added.



Claim 1 is directed to a hermetic compressor. The hermetic compressor of claim 1 has grooves 153 in a closed semi-circular shape placed at the outer circumference of the piston 140. This closed semi-circular shape includes a first outer shape 201 extending towards the skirt side 152 of the piston 140. The closed semi-circular shape includes a second outer shape 202 parallel to the top surface 251 of the piston 140. The closed semi-circular shape also includes a third outer shape 203 linking the first outer shape 201 and the second outer shape 202.

The Official Action, on pages 2-3, asserts that Katayama discloses:

... a piston (23a) making a reciprocating motion in the cylinder (13), and having a top surface and skirt surface, both vertical to a direction of the reciprocating motion, a connecting rod (11) for coupling the eccentric shaft (10) and the piston (23), and an oil supply system (7c) for supplying the oil to an outer circumference of the piston (see abstract), grooves (23e) are provided at an upper side and a lower side of the outer circumferences of the piston, and of an outer shape of the grooves, the outer shape of the grooves communicating with a space in the hermetic container at least when the piston is in a bottom dead center is a shape not forming a parallel line to an axial center of the piston when the grooves are developed in a

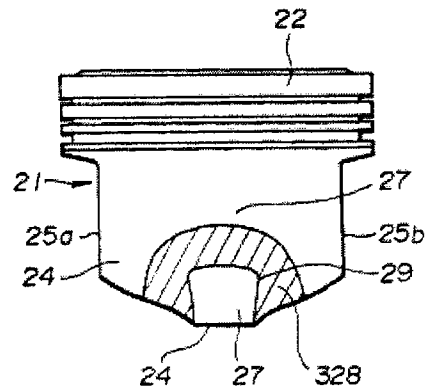
plane ... wherein a through-hole is disposed at about the center of the grooves ... .

Official Action, page 2, line 13 to page 3, line 6. The Official Action readily admits, however, that Katayama fails to disclose the following details of the grooves as taught by Watanabe:

The outer shape of the grooves ... is a contiguous semicircular shape ... extending toward a skirt side of the piston, and the semicircular shape includes a first outer shape extending toward the skirt side of the piston, a second outer shape parallel to the top surface of the piston, and a third outer shape linking the first outer shape and the second outer shape, and a curvature of the first outer shape is smaller than that of the third outer shape ... .

Official Action, page 3, lines 8-16. The Official Action asserts that Katayama in view of Watanabe discloses Applicants' claim 1.

Applicants' respectfully submit, however, that Watanabe fails to disclose, teach or suggest **the outer shape of the grooves as a closed semicircular shape extending toward a skirt side of the piston**. As shown below in FIGS. 1 and 9 of Watanabe, the grooves 28 and 328 are not closed. In FIG. 1, groove 28 extends all the way to the end of the skirt side of the piston. In FIG. 9, groove 328 also extends all the way to the end of the skirt side of the piston. This means that grooves 28 and 328 are open shapes and are **not closed semicircular shapes** as required in Applicants' claim 1.



**FIG. 1**

**FIG. 9**

Because the closed semicircular outer shape of the grooves extends toward a skirt side of the piston, lubricity is improved. As described in Applicants' specification at page 11, line 22 to page 12, line 10, because of the shape of the groove, more oil may be stored in the groove when the piston is in the bottom dead center position. This additional oil allows for a better seal between the piston and the cylinder. This results in enhanced volume efficiency and enhanced refrigerating capacity. (See specification at page 12, lines 9-10). As also described in Applicants' specification at page 12, line 23 to page 13, line 5, the shape and curvature of the groove also prevents large inclination of the piston. By preventing large inclination of the piston, refrigerant leakage is further prevented. This decreases the lateral pressure load to the sliding parts, prevents local wear and enhances the reliability of the sliding parts.

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Independent claims 6 and 12 while not identical to claim 1, include features similar to claim 1. Accordingly, claims 6 and 12 are also patentable over the art of record for at least the reasons set forth above with respect to claim 1.

Claims 2-3 and 7-10 include all of the features of either claim 1 or 6 from which they depend. Thus, claims 2-3 and 7-10 are also patentable over the art of record for at least the reasons set forth above.

Claim 5 is rejected under 35 U.S.C. § 103(a) as unpatentable over Katayama in view of Watanabe and further in view of Irino. Claim 5 includes all of the features of claim 1 from which it depends. Irino is directed to a fluid compressing apparatus and is relied upon in the Official Action as disclosing the use of hydrocarbon refrigerants as a refrigerant gas. Irino, however, is silent regarding the shape of the grooves. Accordingly, Irino does not disclose, teach, or suggest that the outer shape of the grooves is a closed semicircular shape. Therefore, Irino fails to make up for the deficiencies of Katayama and Watanabe. Accordingly, claim 5 is also patentable over the art of record for at least the reasons set forth above.

Applicants' invention as recited by claim 11, includes features which are neither disclosed nor suggested by the art of record, namely:

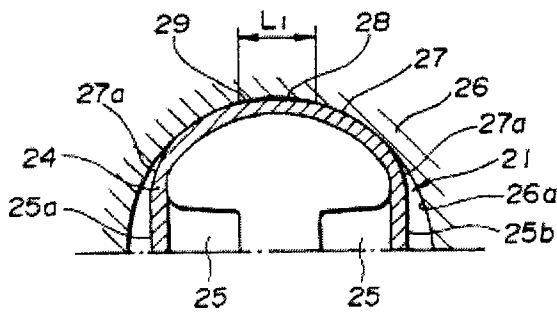
... a piston making a reciprocating motion in the cylinder, and having i) a top surface and a skirt surface, both vertical to a direction of the reciprocating motion and ii) a through-hole ...  
**grooves are provided at an upper side and a lower side of the outer circumference of the piston and disposed around the through-hole** ...

(Emphasis added). These features are found in Applicants' originally filed specification at page 10, line 13. No new matter has been added.

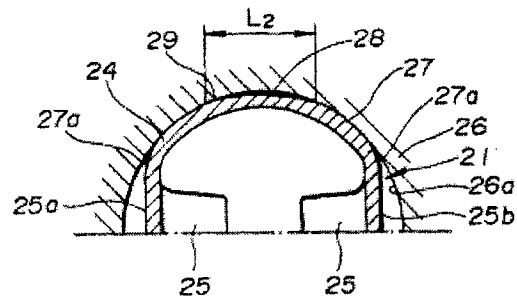
Regarding independent claim 11, the Official Action argues on pages 6, line 23 to page 7, line 2 "... since the grooves [of] Watanabe et al are in a circular or semicircular fashion once modified the grooves will encompass (encircle) the through-hole of Katayama." Applicants respectfully disagree with this assertion.

As shown in Watanabe and as discussed below, the grooves 28 and 328 are purposefully placed away from the through-hole. FIGS. 4 and 5 of Watanabe, reproduced below, show a cross-section cut of the cylinder in FIG. 1 (shown above)

along the line I-I. FIGS. 4 and 5 show the placement of groove 28 to be away from the through-hole.



**FIG. 4**



**FIG. 5**

As shown above, piston boss 25 is on a flat surface 25a, 25b of the piston 24. Watanabe requires that the grooves 28, 328 be located where lubrication is needed between the piston 24 and bore wall 26a. Therefore, the purpose of the grooves 28 are to supply a lubricating oil to the thrust surfaces 27 and 27a to prevent oil film breakage. As shown above, piston boss 25 is equivalent to a through-hole. Piston boss 25 does not come close to contacting bore wall 26a. Thus, there is no need for a groove around piston boss 25 to supply lubrication to the piston to keep it from rubbing against the bore wall 26a. Accordingly, Watanabe teaches away from placing the grooves 28, 328 around the through-hole.

This is **different** because Applicants' claim 11 requires that "... grooves are provided at an upper side and a lower side of the outer circumference of the piston and **disposed around the through-hole** ... ."

Because the grooves are disposed around the through-hole the following advantages are achieved. As described in the Applicants' specification at page 11, line 22 to page 12, line 10, because of the shape of the groove, more oil may be stored in the groove when the piston is in the bottom dead center position. This additional oil allows for a better seal between the piston and the cylinder. This results in enhanced volume efficiency and enhanced refrigerating capacity. (See specification at page 12, lines 9-10). This also allows for more oil to reach the through-hole and lubricate the coupling between the through-hole and the eccentric shaft. As also described in

Applicants' specification at page 12, line 23 to page 13, line 5, the shape and curvature of the groove also prevents large inclination of the piston. By preventing large inclination of the piston, refrigerant leakage is further prevented. This decreases the lateral pressure load to the sliding parts, prevents local wear and enhances the reliability of the sliding parts.

Accordingly, for the reasons set forth above, claim 11 is patentable over the art of record. Withdrawal of the rejection and allowance of the claim is respectfully requested.

### **New Claims**

Claims 13-15 are newly added. Claim 13 is directed to the length of the second outer shape of the groove. Support for this claim may be found in the Applicants' FIG. 3. Claim 14 is directed to the inversion of the first outer shape with respect to the second outer shape. Support for this claim may be found in Applicants' FIG. 3. Newly added claims 13 and 14 depend from claim 1 and include all of the features of claim 1 from which they depend. Thus, claims 13 and 14 are also patentable over the art of record for at least the reasons set forth above.

Claim 15 is also directed to the length of the second outer shape of the groove. Support for this claim may be found in Applicants' FIG. 3. Claim 15 depends from claim 11 and includes all of the features of claim 11 from which it depends. Thus, claim 15 is also patentable over the art of record for at least the reasons set forth above.

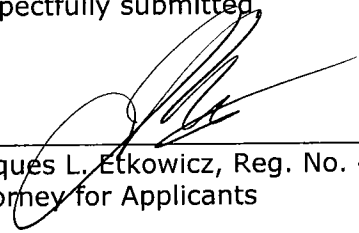
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Reply to Office Action of January 13, 2011

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**Conclusion**

In view of the amendments and arguments set forth above, the above-identified application is in condition for allowance which action is respectfully requested.

Respectfully submitted,



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